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of technical terms in the proper places in the text. Every reader or student should be expected to possess and exercise a memory of sufficient strength to enable him to keep in mind the meaning of the terms used and explained in the text. A glossary which merely re-describes or re-defines is a standing temptation to slovenly reading or study, and in the opinion of the writer, ought never to find a place in ordinary text-books designed for students.

The mechanical execution of the book, in the printing and the binding, is neat, and the typographical errors are notably rare. Professor Underwood deserves and will receive the thanks of the many fern-lovers in the country for giving us this book.—*C. E. B.*

KENT'S MANUAL OF THE INFUSORIA.¹—This will, when completed, be the only available manual of the Infusoria in the English language, the old one by Prichard being superannuated, including as it does diatoms, desmids and Protozoa of all classes. We have looked forward with much interest to the appearance of Mr. Kent's work, and owe to the kindness of a friend an opportunity of looking over three parts which have already been published. It is a much more valuable, extensive and important work than we expected to find, and we can recommend it to microscopists and to the general student as in every way excellent, both in its scientific execution, its fullness of detail, its elaborate and comprehensive introductory portions, which will be read with much interest and profit, and the variety and excellence of its illustrations, the latter of course being an essential feature of such a work.

The first chapter gives the general history of the Infusoria from the time of their discovery, by Leuwenhoek, in 1675, to the year 1880. In the second chapter the sub-kingdom Protozoa is discussed in a way calculated to bring out clearly the relations of the Infusoria to the other classes. Mr. Kent does not regard the Gregarinidæ as entitled to constitute a distinct class of Protozoa, but rather as a "degraded group of the ordinary Rhizopoda most nearly allied to the Amoebina, which exhibit a like modification of structure with relation to the latter as is presented by the Opalinidæ with respect to the ordinary Ciliata." He divides the Protozoa, somewhat unnecessarily we think, according to the degree of differentiation of the ingestive area or mouth, into four sections, naming them as follows: *Pantostomata* (Rhizopoda and a part of the Flagellata); *Discostomata* (the sponges), *Eustomata* (the higher Flagellata and the Ciliata), and (4) the *Polystomata* (including the Tentaculifera alone). We think this sub-division is unnecessary and the nomenclature superfluous, though well calcu-

¹ *A Manual of the Infusoria*: including a description of all known Flagellate, Ciliate, and Tentaculiferous Protozoa, British and foreign, and an account of the Organization and Affinities of the Sponges. By W. SAVILLE KENT, F. L. S., etc. London, David Bogue, 1880. Parts I to III, each 10s. 6d. 8°.

lated to call attention to the successive steps in the differentiation in the Protozoa of a "mouth" or ingestive area.

The author's system does not recognize the *Monera* of Haeckel, and he rather dogmatically relegates them to the Rhizopods, not awaiting further discoveries as to the presence or absence of a nucleus, dismissing them with the remark that since the Foraminifera, included by Haeckel in the group *Monera*, have been proved to possess a nucleus, "A similar demonstration of the possession of nucleolar structures in the few remaining organisms relegated to this group will not improbably result from their further careful examination, with the assistance of the special treatment resorted to in the case of the Foraminifera. Finally, it is altogether questionable whether the presence or absence of a nucleus or endoplast can be accepted as furnishing a distinct and reliable character even for specific diagnosis. This structure, as shown at greater length in the chapter devoted to the organization of the Infusoria, is evidently in many instances an accompaniment only of the matured and reproductive phase."

Mr. Kent also, and here we think with excellent reason, dismisses as "entirely unnecessary and untenable," the *Protista*, a kingdom set up by Haeckel and including all organisms supposed to be intermediate between the plants and animals and comprising the lowest representatives of both; although our author is clearly alive to "the difficulty of indicating a clear line of demarkation that shall arbitrarily separate certain unicellular cryptogamic plants or Protophyta from the unicellular animals or Protozoa." Mr. Kent claims, however, as the result of close investigation on his part upon *Volvox* and *Protococcus* and certain allies of these forms, that he failed to find any periodically contracting vesicles, and he thinks that the absence of a contractile vesicle is characteristic of these lowest plants.

Our author regards the Myxomycetes or *Mycetozoa* as belonging to the animal kingdom, remarking that "the evidence most recently and independently eliminated by L. Cienkowski and Dr. A. de Bary, concerning the structure and life-history of this most remarkable group, establishes, however, beyond question their purely animal nature. The Mycetozoa, in common with all ordinary representatives of the Protozoa, originate from minute sporoid bodies which escape from the spore case as monadiform animalcules having a soft, plastic body-substance, a single terminal flagellum, contractile vesicle and endoplast or nucleus, being thus in no way distinguishable from the typical representatives of the ordinary Flagellata-Pantostomata, as met with in the genus *Monas*." He then farther recapitulates their later developmental stages, and gives good reasons for their Protozoan nature.

Another singular and doubtful group, the Labyrinthulida, are likewise referred by Mr. Kent, to a position in the Protozoa midway between the Foraminifera and the Myxomycetes. The sponges

are by Mr. Kent regarded as forming simply a single order (Spongida) of Flagellate Infusoria and standing next to his order of Choano-Flagellata, represented by the stalked, collared *Codosiga*, *Salpingoeca*, and *Protospongia*.

The structure of the Infusoria proper, are then described with much clearness and detail, as well as their reproductive phenomena, the author devoting considerable space to the modern view of Balbiani and the opposing one of Engelmann and Bütschli as to the nature of reproduction in the Infusoria. While not accepting Balbiani's views, afterwards confirmed by Kölliker, Stein, Claparède and Lachmann, that the nucleus is an ovary and the nucleolus is a testis, and that certain Infusoria reproduce by eggs fertilized by seminal particles analogous to those of the higher animals, the author insists that germs or embryos are in several forms produced by the subdivision of the nucleus. He also maintains that the process of conjugation, especially in the *Vorticellidæ*, where it is complete and permanent, and so far as is known in all the Flagellata, the larger individual corresponds to the female element, or egg, and the smaller to the male element, or spermatozoön.

Sections follow on the affinities of the Infusoria to the higher animals, their distribution, the modes of preserving them for study, the methods of investigation, while the fourth chapter is devoted to a discussion of the doctrine of spontaneous generation.

The succeeding chapter on the nature and affinities of the sponges comprises a long discussion of the question as to the position of the sponges in the animal kingdom, with the result of considering them as an order of Flagellata Infusoria, allied to *Codosiga*, etc., a view first proposed by Professor H. James Clark, of this country. The historical treatment of the subject is just to other observers and moderate and original in the views presented. Mr. Kent believes with Clark that the sponges are colonies of collared flagellate infusoria, and considers that the *Protospongia* is the connecting link between the genuine Flagellata with a collar and the sponges. He considers that the fact that the collared cells lining the ampullaceous sacs of the sponge have a contractile vesicle like genuine Infusoria, is a powerful argument in favor of their Flagellate affinities. The strongest argument against the Protozoan nature of sponges, is the fact that they are now generally recognized to develop from true eggs, which are fertilized by genuine spermatozoa, and that the eggs undergo segmentation, passing through a condition at least analogous, if not homologous with the morula and gastrula, or at least planula of the *Cœlenterates*. We have not space to give the author's arguments, even in a condensed form, and would only state that they are well put and cogent, while at the same time, throwing out Haeckel's work, whose merits Mr. Kent is disposed we think to somewhat underrate, and confining ourselves to the result of the elaborate and careful observations of Melschnikoff, F. E. Schultze and

Barrois, we fail to be convinced that the sponge is not a many-celled animal, reproducing by eggs and passing through stages comparable with the mulberry and planula stages of the jelly fishes. If the reader, after studying the works of the above named authors, will then read the admirable summary of the embryology of sponges in Balfour's Comparative Embryology, we think that he will be inclined neither to accept the view that the sponges are on the one hand genuine Protozoa, nor on the other genuine Metazoa. In this connection the suggestions of Balfour as to the Protozoan affinities of the sponges will have much weight. The arguments of Mr. Kent have made a strong impression on us, and have led us, while believing that the sponges represent a distinct subkingdom, to look with more favor than heretofore on the close relations of the sponges to the Protozoa. Indeed, we should feel strongly inclined to the view that the sponges belonged to a category or super-branch, as we might consider it, intermediate between the *Protozoa* and *Metazoa*, to which the term *Spongozoa*, already used, might well be applied. We do not see why the so-called eggs of sponges are not such, even if they are originally amœba-like forms, that of *Hydra* being at one time amœbiform. Kent has studied more closely than any one else the so-called spermatozoa of the sponges, and concludes that they simply correspond to the spores which originate from the collared Flagellata, but we should hazard the opinion that his facts may be interpreted in an opposite way, and judging from his drawings do not see why his cells (see Pl. x, fig. 11, b on upper edge of figure) containing spores do not correspond to the mother-cells inclosing the incipient spermatozoa of higher forms of Metazoa. The lining cells of the ampullaceous sacs, even if they are collared, appear to us to fairly represent the epithelial tissue of hydra and higher animals, though forming a less homogeneous, differentiated tissue; why should not, as in Metazoa, certain of the epithelial cells become specialized in the manner described by Kent, and form egg-cells and sperm-cells? The striking individuality of the sponge-cells and their power of ingesting living algæ and other minute organisms have lately been shown to exist by different observers in different Cœlenterates. We owe to Messrs. James Clark and Saville Kent, we are bound to say, strong arguments for the Protozoan affinities of the sponges, but when we balance their observations and conclusions with those of Haeckel, Metschnikoff, Schultze and Barrois, we cannot resist the impression that the sponges should stand as an independent branch half way between the Protozoa and Cœlenterates or Metazoa in general. They are the connecting links between the unicellular and the many-celled animals; between those without tissues and germ-layers, and those with genuine tissues and definite cell-layers. We may fail to apply the terms ectoderm, mesoderm and endoderm to the but partially differentiated tissues

of the sponges, we may deny them a true morula and gastrula condition, but still they will be found to wonderfully anticipate the Metazoa in these respects, and will thus serve as transition forms, connecting at many points the Protozoa and Metazoa, and showing that the distinction involved by these terms is more or less artificial. By a study of the sponges we can see how it has been possible for tissues and germ layers to have had an origin. In short, to regard the sponge as Protozoa, seems to us as extreme as to consider them as forming a division of Cœlenterates.

The systematic part of Mr. Kent's work is well done, the generic and specific characters are given in much detail. The work is evidently the result of much labor and skill, in microscopic observation and delineation, and will, we feel sure, incite many others to study these infinitesimal forms.

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